Magic squares and circles

Benjamin Franklin's Numbers
by Paul C. Pasles
Princeton University Press: 2007.
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Jared Wunsch

Benjamin Franklin was a brilliant amateur scientist in an era when amateur science mattered. His experiments on electricity won him the Royal Society's Copley Medal in 1753 — it is to Franklin that we owe the notion of positive and negative charges. He charted (and named) the Gulf Stream. His prodigious inventions include the lightning rod, the glass harmonica, bifocals and the Franklin stove.

In *Franklin's Numbers*, a book mixing intellectual history and mathematical puzzles (with solutions appended), Paul Pasles brings out a less-celebrated sphere of Franklin's intellect. He makes the case for the founding father as a mathematician. Franklin's main contribution to the subject was his work on magic squares, and these are the focus of the book.

Even bent rows (1, 8, 13, 12, for instance) of Franklin's notes sum to 34.

A magic square is, in its traditional formulation, an $n \times n$ grid containing the numbers 1 to n^2, such that all rows, all columns, and both diagonals sum to the same number. Franklin, characteristically, improved on the usual form, producing squares that could be summed in more intriguing ways, along 'bent rows', for example. He also concocted several magic circles as a further novelty.

Franklin was diffident on the subject of his work on magic squares, sheepishly admitting to having spent time on them out of proportion to the subject's utility. Pasles takes up the defence of Franklin's squares, correctly pointing out that utility is not a suitable measure for a piece of mathematics and that future applications are notoriously hard to predict.

It is here that the case starts to become shaky. The number theorist G. H. Hardy wrote in his *Mathematician's Apology* in 1940 that "the best mathematics is serious as well as beautiful", going on to assert that "the 'seriousness' of a mathematical theorem lies not in its practical consequences ... but in the significance of the mathematical ideas which it connects". By this measure, magic squares, entertaining though they are, rank mathematically just a little higher than chess problems (Hardy's example of real but unimportant mathematics).

Perhaps Franklin just came too late to pure mathematics, already a mature field in his era, but early to electricity, where the work of a gentleman researcher could still be ground-breaking. It was Franklin's electrical work, viewed in the light of Maxwell's equations, that gave us genuine mathematical magic. ■

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Fruits of their labour

Status of Pollinators in North America
by The Committee on the Status of Pollinators in North America, National Research Council of the National Academies
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Forests, prairies, meadows, seashores and wetlands all depend on a diverse and healthy community of pollinators. Wild pollinator populations living in intact and healthy forests, woodlands and fields contribute to the success of a variety of crops — including coffee, watermelons, cucumbers and sunflowers.

It is therefore troubling to hear that pollinator populations are declining or at risk of extinction, the sobering subject of the *Status of Pollinators in North America*. This is a report by a US National Research Council committee, created in 2005 to assess the reality and causes of pollinator declines in agricultural and natural systems, and to offer recommendations to ensure the long-term stability of pollination services.

The committee synthesized the results of some 1,200 research articles and reports, focusing on empirical studies of pollinators and their effects on wild and domesticated plant species. No pollinator escapes: changes in population size and distribution of pollinating ants, bees, wasps, beetles, flies, butterflies, moths, birds and bats are all summarized.

The committee casts an even wider net by enlisting the expertise of applied researchers, honeybee specialists, non-governmental organizations, managers of pollinator databases and industry consultants, who all participated in a symposium at the National Academies in 2005.

A few basic facts highlight the value of domesticated and wild pollinators, and the risks that they face. Honeybees (*Apis mellifera*), the most widely managed, carefully monitored, and commercially distributed pollinator, are used for the fruit and seed production of more than 100 crops (all non-cereals) in the United States. Estimates of their economic value in the United States range from $150 million (at present, the total annual cost of bee-colony rental) to almost $19 billion (the estimated value that farmers would pay if pollinators weren't freely available in nature).

For some crops, honeybees are ineffective pollinators compared with native bees or man-

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Unhappy honeybee: efforts are afoot to restore plummeting pollinator populations.